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Industry 4.0 for a Sustainable World: Water Treatment and Hydropower

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Participating Institutions:

- Gymnazium Teplice, Teplice, Czech Republic;
- SZ Geschwister Scholl, Bremerhaven, Germany;
- La Salle Buen Consejo, Puerto Real, Spain;
- Siauliu Didzdvario gymnasium, Siauliai, Lithuania.

TEPLICE

SZ GESCHWISTER SCHOLL
Gymnasiale Oberstufe Bremerhaven

La Salle
N.ª S.ª del Buen Consejo

EX NIHILO NIHIL FIT
DIDŽDVARIO GIMNAZIJA

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Description of the final project (1)

- After research and taken consideration of topic's importance to our everyday life we thought about **main questions that should describe hydropower and wastewater treatment** in Lithuania and answered them in this project.
- We compared Lithuania's production of electricity in hydropower plants and other statistics about water to other countries: Spain, Germany, Czech Republic.
- We also did an experiment where we tested water from different parts of the Šiauliai city and compared gotten results, wrote reasons why water's quality may be different.

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Description of the final project (2)

To sum up, **in this project we talk about**:

- hydropower in Lithuania and Europe,
- water and wastewater treatment
- describe experiment on water quality in Šiauliai city.

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Participating students

Siauliu Didzdvario gymnasium, Siauliai, Lithuania
*(*Gymnazium Teplice, Czech Republic; SZ Geschwister Scholl, Germany; La Salle Buen Consejo, Spain)

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Water treatment and hydropower

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1. Characteristic and classification

- Industrial water is used for fabricating, processing, washing, diluting, cooling, or transporting a product.
- Water is also used by smelting facilities, petroleum refineries, and industries producing chemical products, food, and paper products.

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2. History of hydropower in Lithuania

- History of hydropower in Lithuania **started in 1900** when first small hydropower plant was built.
- In 1909 first researches on how to use hydro energetics of the biggest river in Lithuania – **Nemunas** – began.
- At the moment in Lithuania there are **82** small hydropower plants and **2** big hydropower plants.

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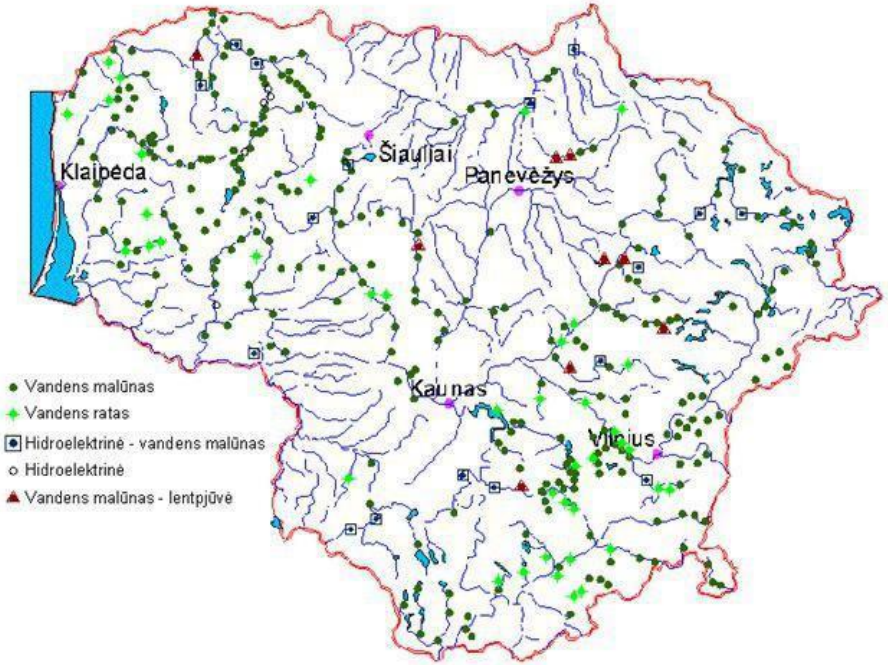

Hydropower plants in Lithuania

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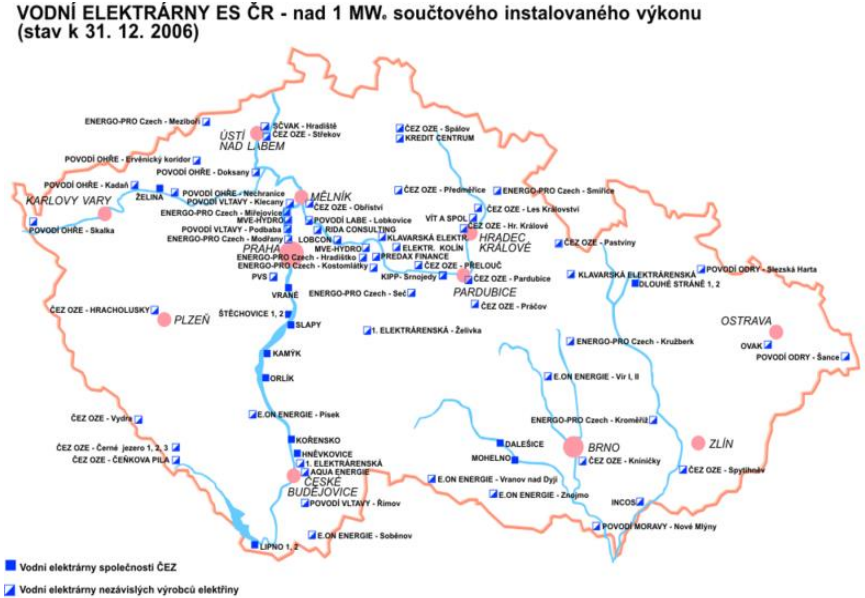
3. Localization of Water treatment and hydropower

Most hydropower plants are located near Vltava and Elbe rivers, in the area near Praha and Melnik (Mělník).



Map of hydropower localization in Czech Republic

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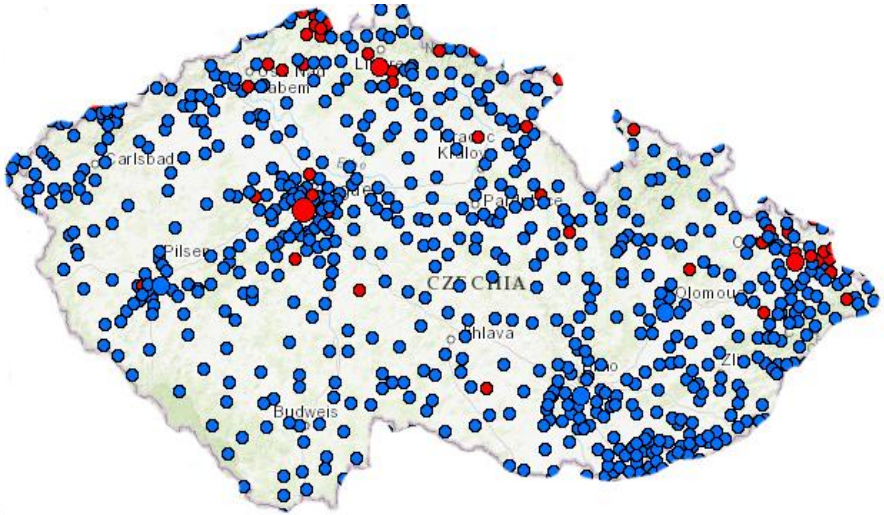
3. Localization of Water treatment and hydropower



Water treatment plants localization in Czech Republic

Most of the water treatment plants are located in Southern part of Czech Republic.

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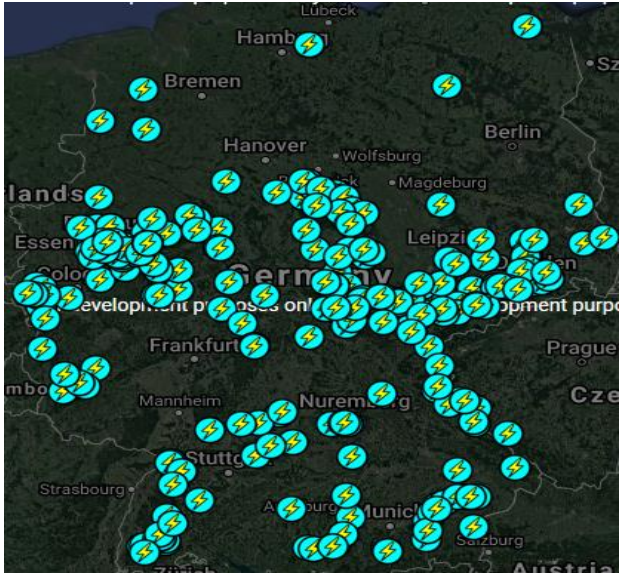
3. Localization of Water treatment and hydropower

Water treatment plants are located all over the Germany



Most of hydropower plants are located in Central Germany

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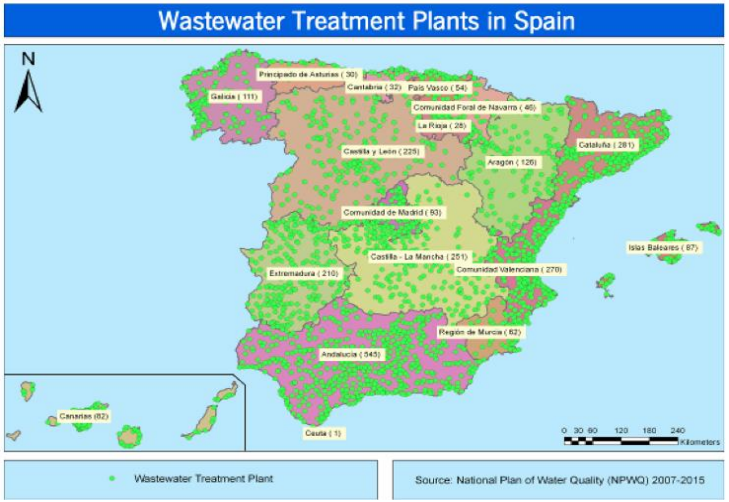
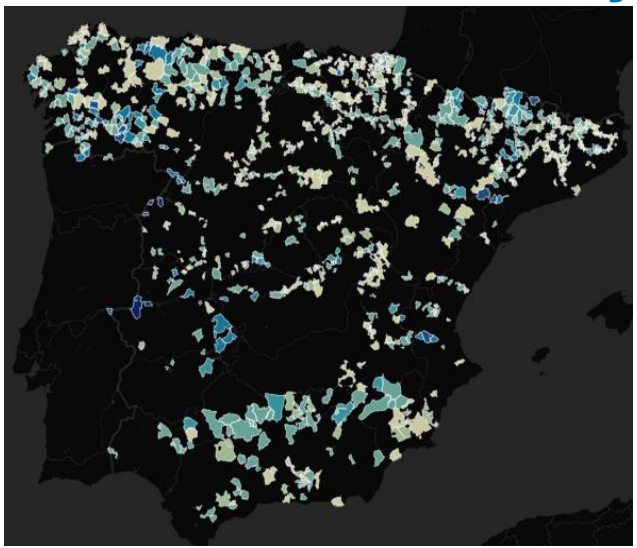
3. Localization of Water treatment and hydropower



Wastewater Treatment Plants in Spain



Most of the hydropower plants are located in northern Spain and southern Spain

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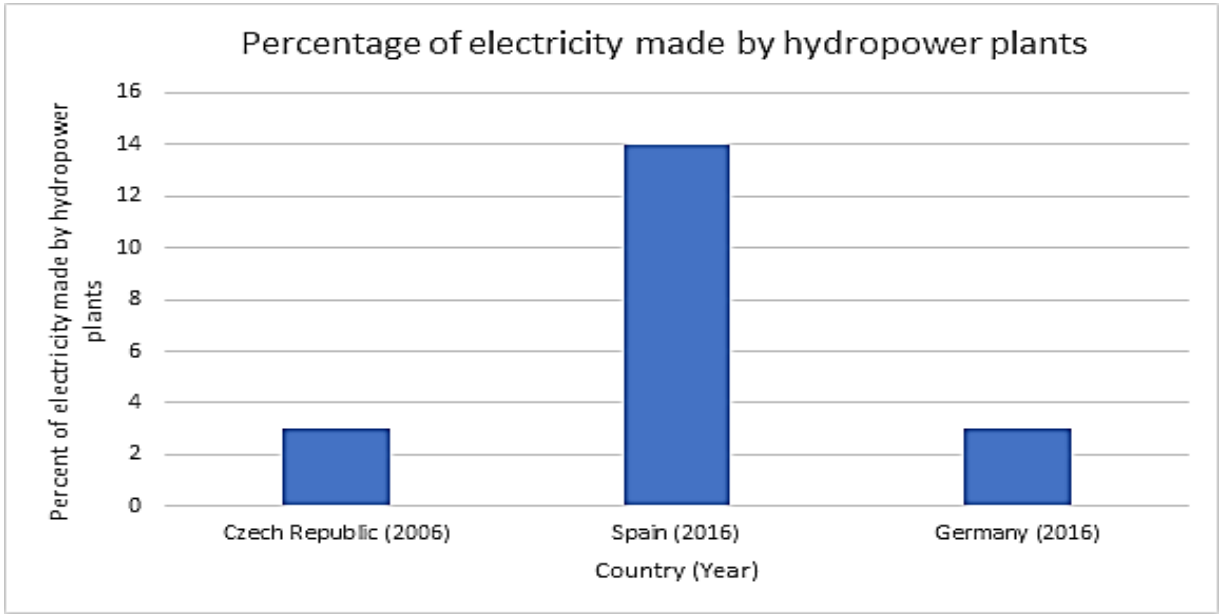
3. Localization of Water treatment and hydropower



Percentage of electricity made by hydropower plants

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4. Kaunas Hydroelectric Power Plant

Kaunas Algirdas Brazauskas' Hydroelectric Power Plant (the KHPP) is **the largest power plant** in Lithuania using renewable resources.

Kaunas Hydroelectric Power Plant location (Google maps picture)

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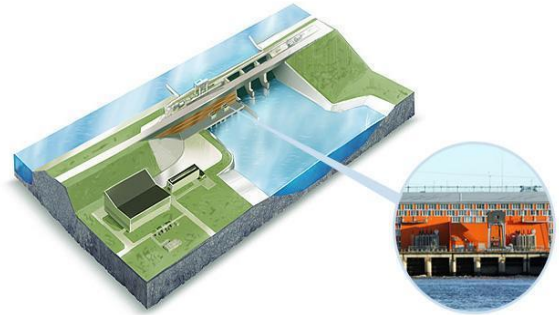
4. Kaunas Hydroelectric Power Plant

The modern design of hydro-turbines ensures their safe exploitation Currently, the KHPP meets all the appropriate requirements for **environmental protection.**



The KHPP after being modernized in 2010

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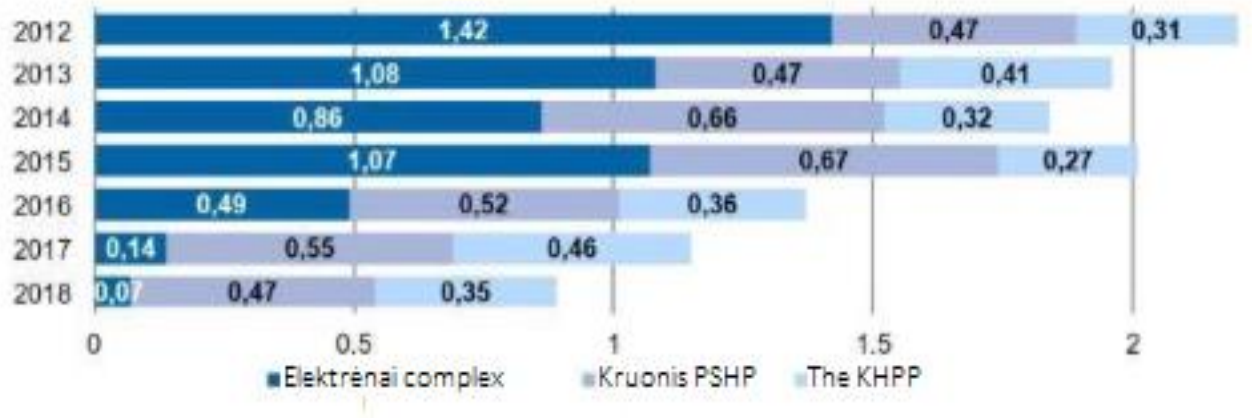
4. Kaunas Hydroelectric Power Plant



Comparison of the KHPP electricity production per year to the other electricity production companies in Lithuania (taken from "Ignitis group" official statistics)

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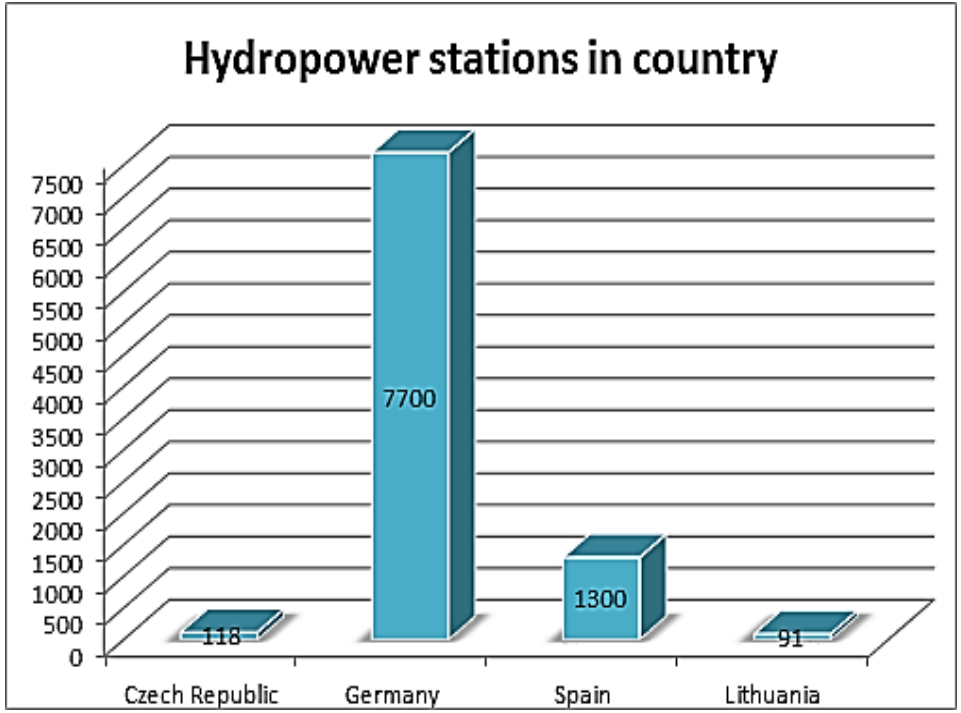
5. Quantification of Water treatment and hydropower



Compared industries between countries according to data that was received from Czech Republic, Germany, Spain and Lithuania students.

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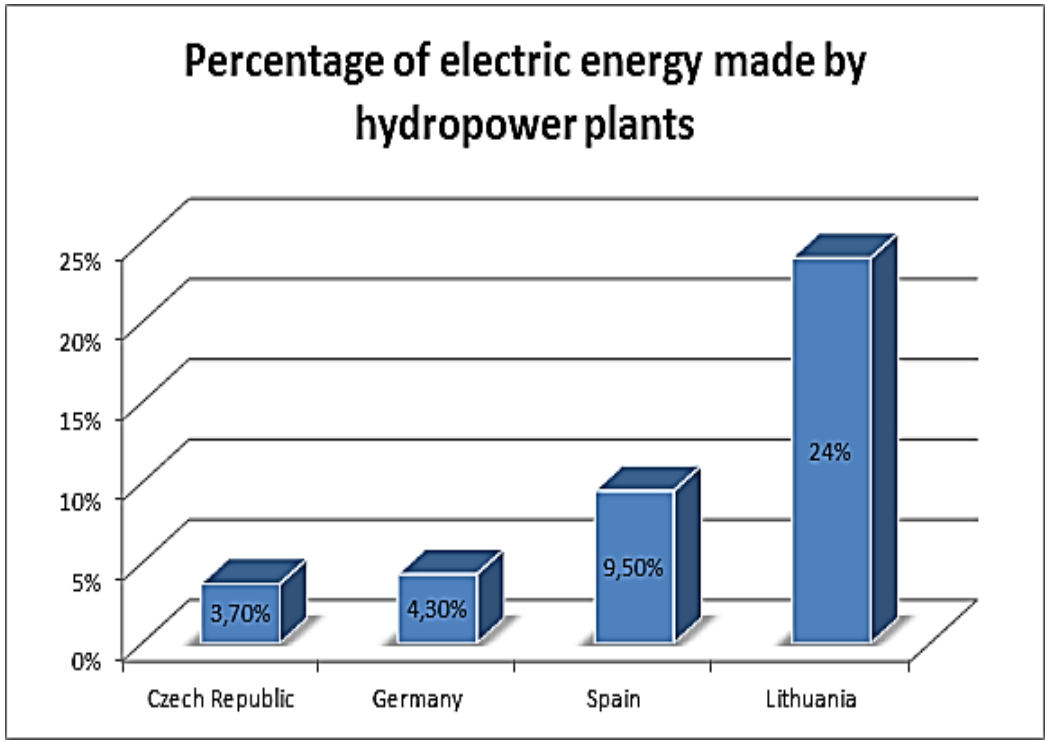
5. Quantification of Water treatment and hydropower



Percentage of electric energy made by hydropower plants is the biggest in Lithuania (24 %) and smallest in Czech Republic (3,7 %).

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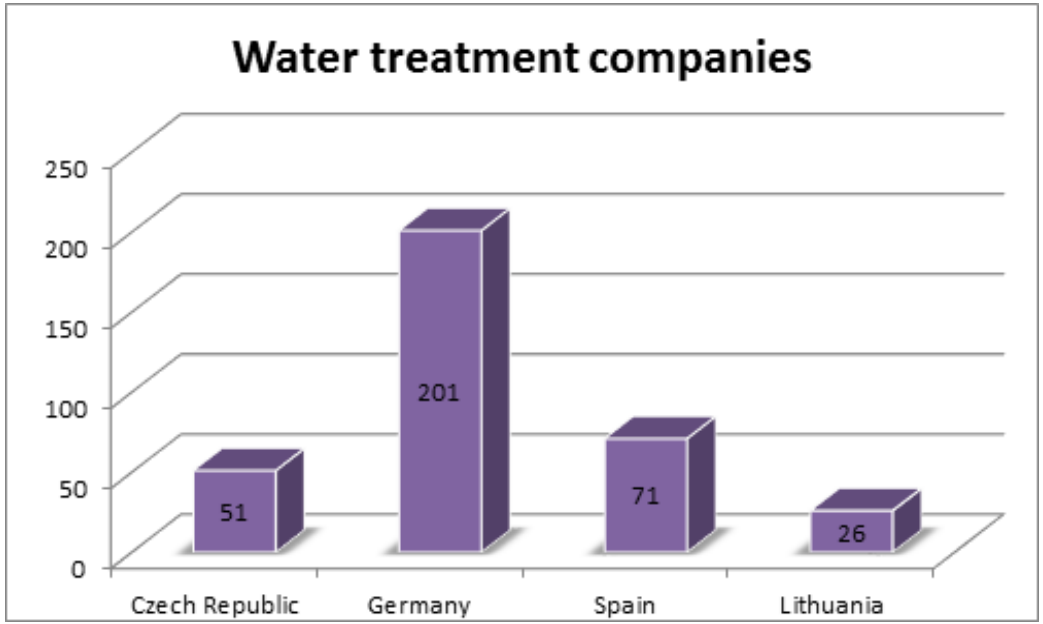
5. Quantification of Water treatment and hydropower



Germany has the **largest number** of water treatment companies (201) and Lithuania has the least (26).

Data from: www.environmental-expert.com, 2020

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6. Bacteriological Quality of Drinking Water

An experiment

- **The aim of this project** was to determine which water is the most suitable for drinking. Identify if it’s microbial pollution.
- A two-day study was conducted.
- The first day, samples were prepared for the test, the next day the test results were processed and evaluated.

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6. Bacteriological Quality of Drinking Water

Work process (1)

- Remove caps from flasks containing test water
- Burn down the necks
- Gently rinse the water and put 1ml. of undiluted tap water into two sterile petri dishes using sterile pipette and Immediately after that pour 12–15 ml. of sterilized, melted and till 45–50 C degrees cooled down agar.

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6. Bacteriological Quality of Drinking Water

Work process (2)

- Right after that, spin the dish lighty to mix the medium with the water, but do it gently so that it wouldn’t leave empty spaces on the bottom of the dish, make air bubbles or splash the cap.
- Then leave dishes on the table and let agar to freeze after that put dishes up side down into thermostat (37 ± 0,5°C) and leave for 24 ± 2 h.

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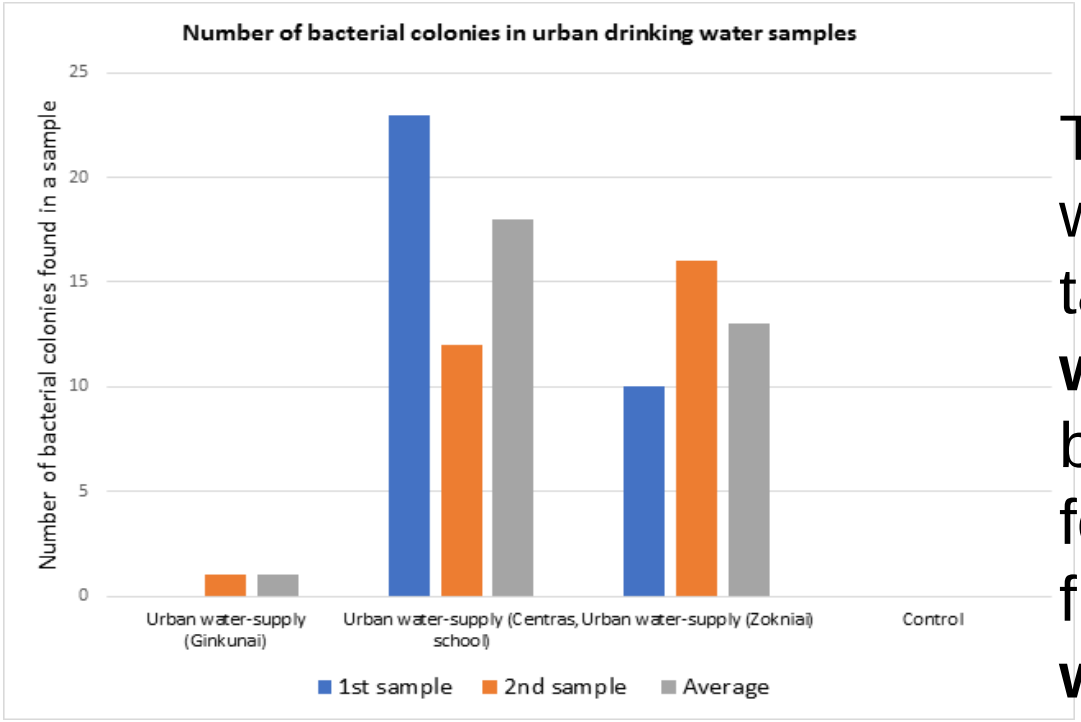
6. Bacteriological Quality of Drinking Water



The most bacterial colonies were found in samples taken from **school's urban water-supply**, least bacterial colonies were found in samples taken from **Ginkunai urban water-supply.**

Number of bacterial colonies in urban drinking water samples

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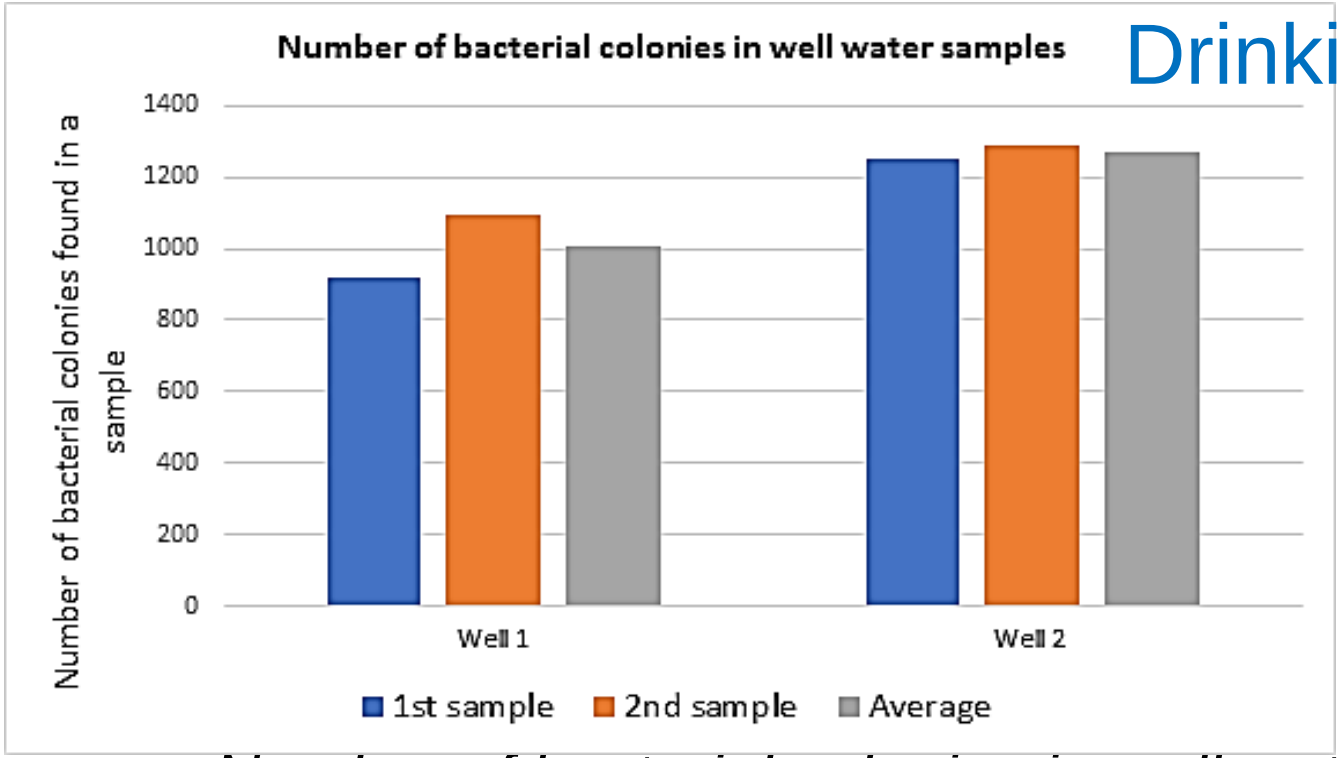
6. Bacteriological Quality of Drinking Water



Number of bacterial colonies in well water samples

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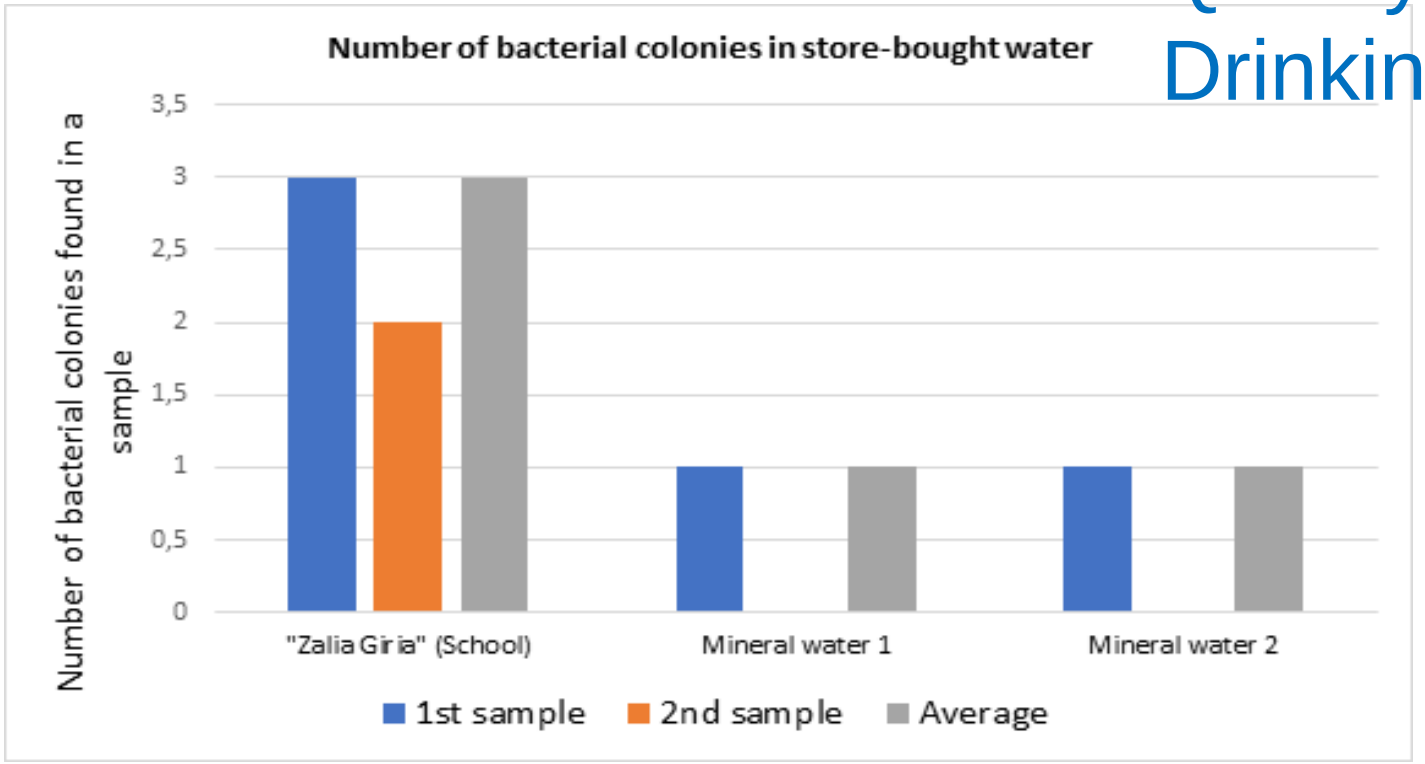
6. Bacteriological Quality of Drinking Water



Number of bacterial colonies in store-bought water

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6. Bacteriological Quality of Drinking Water

In conclusion, the most bacterial colonies were found in water from the well number 1 (The average of 1271 bacterial colonies).

Student Žygimantas analyzes the final result

The least bacterial colonies were found in Urban water supply (Ginkūnai district) (Average of 1)

Picture of samples from the experiment

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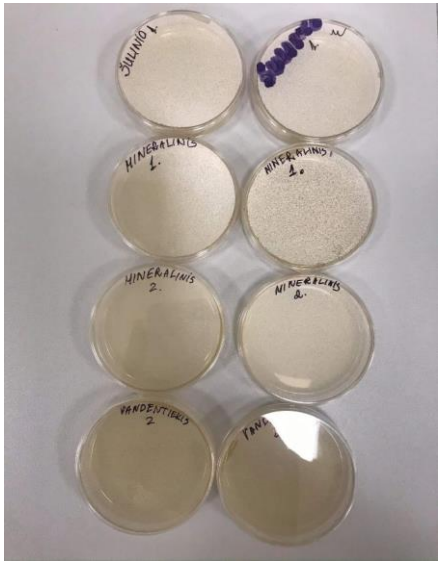
6. Bacteriological Quality of Drinking Water

Petri dishes on the thermostat



All test samples: urban, mineral, well water

Project participants in the process

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6. Bacteriological Quality of Drinking Water

Work progress

Writing down results

Making new samples

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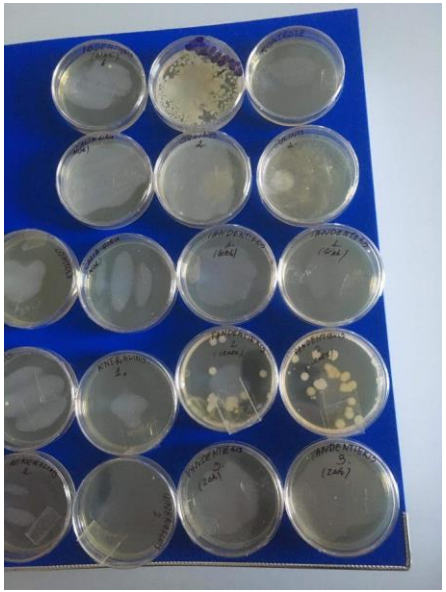
6. Bacteriological Quality of Drinking Water

The all samples



We got this result in the end

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6. Bacteriological Quality of Drinking Water

Conclusion of experiment:

- In the control water sample, grew **zero** bacterial colonies.
- The least amount of bacterial colonies grew in both mineral water samples and an urban water supply sample from the **Ginkūnai district**.
- The average number of bacterial colonies in all 3 samples equals.

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6. Bacteriological Quality of Drinking Water

Simple Things You Can Do To Improve Water Quality in Your Home:

- **Flushing:** Run cold water taps for two minutes before using water for drinking and cooking.
- **Cold Water Use:** Do not use hot tap water for drinking and cooking.
- **Water Filters:** Routinely replace filter cartridges.

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6. Bacteriological Quality of Drinking Water

- **Household Plumbing:** Replace old household plumbing and potential lead sources.
- **Faucet Aerators:** Routinely clean faucet aerators and replace them as needed.
- **Water Heaters:** Drain your water heater annually.

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7. Final Conclusion (1)

- Water in Lithuania is **being used mostly** for pisciculture, agriculture, industrial needs, households.
- Currently in Lithuania there are **82 small** hydropower plants ant **2 big** hydropower plants (Kaunas HPP and Kruonis PSP).
- The modern design of hydro-turbines **ensures their safe** exploitation (no oil enters the waters of the Nemunas).

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7. Final Conclusion (2)

- Lithuania has **the least** hydropower stations (91).
- Percentage of electric energy made by hydropower plant s is **the biggest** in Lithuania (24 %).
- Lithuania has the least water treatment companies (26).
- Lithuanian tap water is among **the cleanest in Europe** and is perfectly drinkable.

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7. Final Conclusion (3)

And if we are talking about the water in Lithuania, we are really lucky at this point **Lithuania is one of the few countries in the world with large reserves of fresh groundwater.** Groundwater is of much better quality than surface water: saturated with useful minerals and protected from microbiological contamination.

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Students´ experience with this project:

To make world a better place we all must work together and make some changes now because it can be too late in the future.

This project was a good opportunity to learn about industry 4.0 and hydropower. We expanded our knowledge about these things. Also, it was a great opportunity to interact with more people, work with them on this project and get out of our comfort zone sometimes.

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Software:

Microsoft Excel, Microsoft PowerPoint, Microsoft Word;

Vernier software Logger Pro, Google Drive,

Google Chrome